some success by the 82nd Airborne Division and XVIII Airborne Corps. The current distribution plan for the SECOMP-I is shown below. Fielding dates are not set.

Command Version (C)
Standard Version (S)

	(C)	(S)
XVIII Airborne Corps	16	22
V Corps	7	8
I Corps	5	6
75th Ranger Regiment	10	13
USASOC	12	22
25th ID	3	5
175th SIB	1	3

ARMY SINGLE CHANNEL SATCOM VIA MILSTAR

Milstar differs from the UHF constellations in that it will support both single and multichannel communications through different Milstar ground terminals. For the purposes of this chapter, we will only discuss its single channel attributes. Milstar, the newest DoD satellite constellation will provide EHF LDR at up to 2.4 kbps for single channel communications using the SCAMP ground terminal, AN/PSC-11.

The entire Milstar constellation will consist of six satellites. The first two Milstar I satellites have LDR-only capability. The remaining four Milstar II satellites, once launched, will have Medium Data Rate (MDR) EHF capabilities which increases channel capacity to 1.544 Mbps. The LDR portion of the communications payload will be discussed in this section. The MDR portion will be discussed in Chapter 5, Multichannel SATCOM.

Geographic usable coverage by the Milstar space segment is worldwide between 65 degrees south and 65 degrees north (figure 4-7). In this figure, the overlapping coverage shows the range of the current two satellites on orbit now and the projected coverage of the remaining four satellites yet to be launched.

Crosslinks between the Milstar satellites permit worldwide communications without the use of ground stations. This is helpful in a jamming scenario. The Milstar satellites employ the EHF frequency band for the following reasons:

- Narrow antenna beams for low probability of interception and detection, anti-jamming, and spatial diversity.
- Wide bandwidth for anti-jam processing
- Combinations of earth coverage, agile, wide and narrow spot antennas provide appropriate power levels for each type of earth terminal.

Milstar differs from the UHF constellations in that it will support both single and multichannel communications through different Milstar ground terminals.

The Milstar LDR Payload

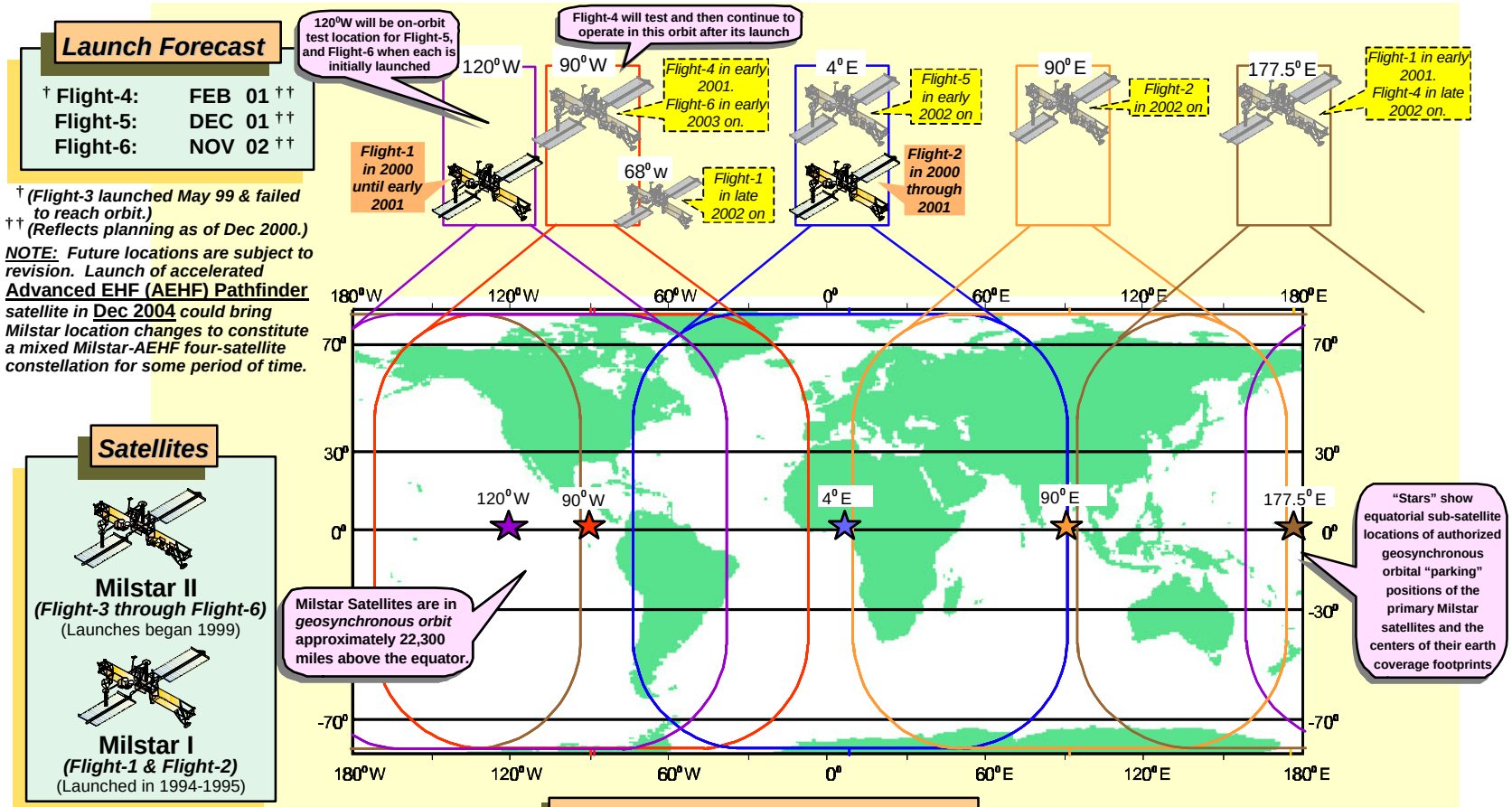
The Milstar LDR payload supports the single channel communications available using the Milstar I satellite constellation. The Milstar LDR payload is shown as a separate block diagram (figure 4-8) and again, as an integrated package in the overall Milstar communications payload (figure 4-9).

Crosslinks between the Milstar satellites permit worldwide communications without the use of ground stations.

There are nine EHF uplink beams; one earth coverage, one wide spot beam, two narrow spot beams, and five agile beams; there are five downlink beams as shown. The LDR comprises 75 bps, 150 bps, 300 bps, 600 bps, 1.2 kbps, and 2.4 kbps. There is the capability to crossband from EHF to UHF and vice versa. The Milstar payloads provide on-board processing of incoming signals so that addition and subtractions of user terminals does not require power and bandwidth balancing.

The LDR crosslink consists of a classified number of 75 bps crosslinks and 600 bps crosslink slots. If a

Figure 4-7 Milstar EHF* Satellite Constellation and Coverage Areas



Milstar Satellite Capabilities

Milstar II Satellites

• Processed Channels:
- *Low Data Rate (LDR*) EHF/SHF**:
  -- Max. 192 channels (ranging from 75 bps to 2.4 kbps), **-OR-**
  -- Max. 100 channels (all 2.4 kbps)
- *Medium Data Rate (MDR*) EHF/SHF*:
  -- 32 channels (ranging from 4.8 kbps to 1.544 Mbps (T-1)
- *UHF* AFSATCOM II-R*:
  4 channels (75 bps frequency-hopped receive & 75 bps non-hopped transmit)
- *UHF Fleet Broadcast*:
  1 transmit channel at 1.2 kbps (channel is received via LDR EHF)
- *Intersatellite Crosslinks*:
  Four 60-GHz frequencies available

• Antennas:
- *LDR EHF Receive*:
  -- 1 Earth Coverage horn
  -- 5 Agile Beam arrays
- *LDR SHF Transmit*:
  -- 1 Earth Coverage horn
  -- 1 Agile Beam array
- *LDR EHF/SHF Receive/Transmit*:
  -- 2 Narrow Spot parabolics
  -- 1 Wide Spot parabolics
- *MDR EHF Receive*:
  -- 2 Nulling Spot Beam
- *MDR SHF Transmit*:
  -- 2 Wide-Area Spot Beam
- *MDR EHF/SHF Receive/Transmit*:
  -- 6 Medium-Area Spot Beam (for distributed user coverage area)
- *UHF*:
  -- 1 Receive Helix
  -- 1 Transmit Helix
- *Crosslinks*: 2 steered parabolics

• Transmitters:
- *LDR SHF (20.2-21.2 GHz)*:
  -- Four 25-Watt transmitters
- *MDR SHF (20.2-21.2 GHz)*:
  -- Three 60-Watt transmitters
- *Crosslinks (60 GHz)*:
  -- 4 transmitters
- *UHF (243.7-244.5 MHz)*:
  -- 1 AFSATCOM II-R transmitter
  -- 1 Fleet Broadcast transmitter

Milstar I Satellites

Capabilities are same as Milstar II satellites except for the following:

- Milstar I lacks all the MDR EHF capabilities that are shown for Milstar II satellites

- Milstar I has only two crosslinking frequencies (versus four for Milstar II)

*LDR = Low Data Rate (75 bps - 2.4 kbps)
*MDR= Medium Data Rate (4.8 kbps - 1.544 Mbps (T-1))

*EHF/SHF = Extra High Frequency/Super High Frequency; for Milstar, EHF is the uplinking in the V-Band on 43-45 GHz & SHF is the downlinking in the K-Band on 20.2-21.2 GHz.

*UHF = Ultra High Frequency; U.S. Military UHF satellites operate in the Military UHF-Band that spans 225 - 400 MHz.

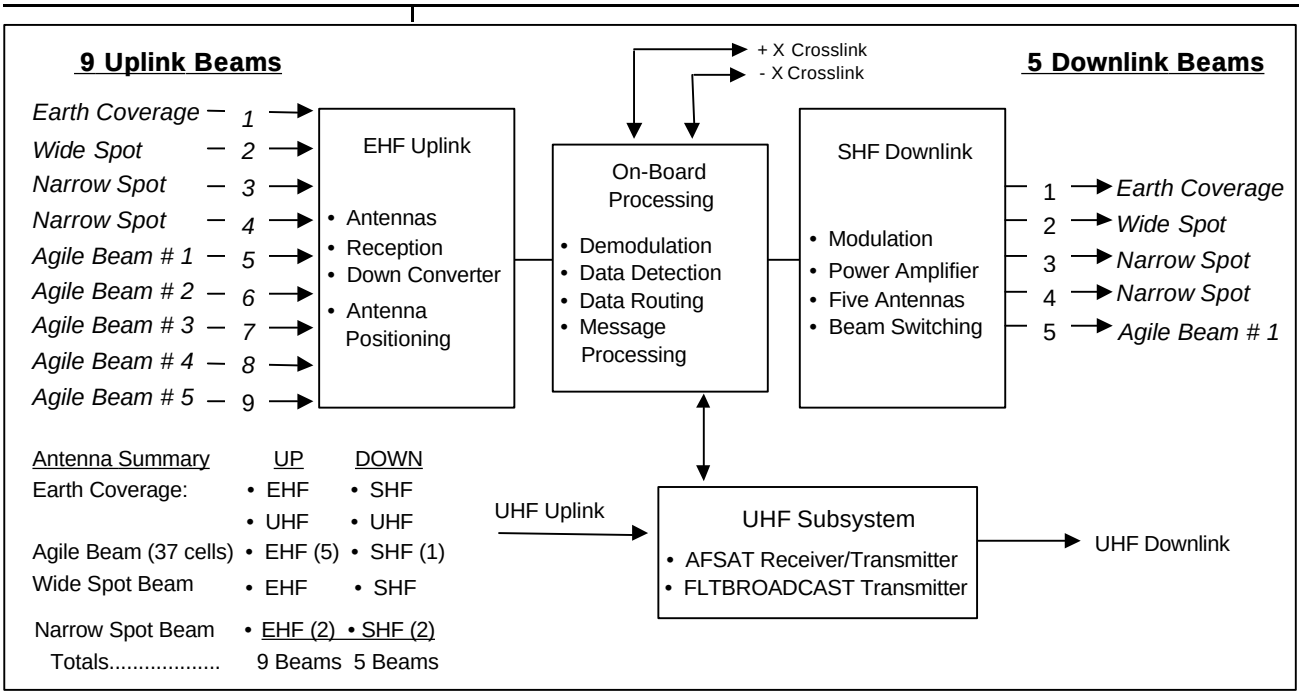


Figure 4-8. Milstar LDR Payload Block Diagram

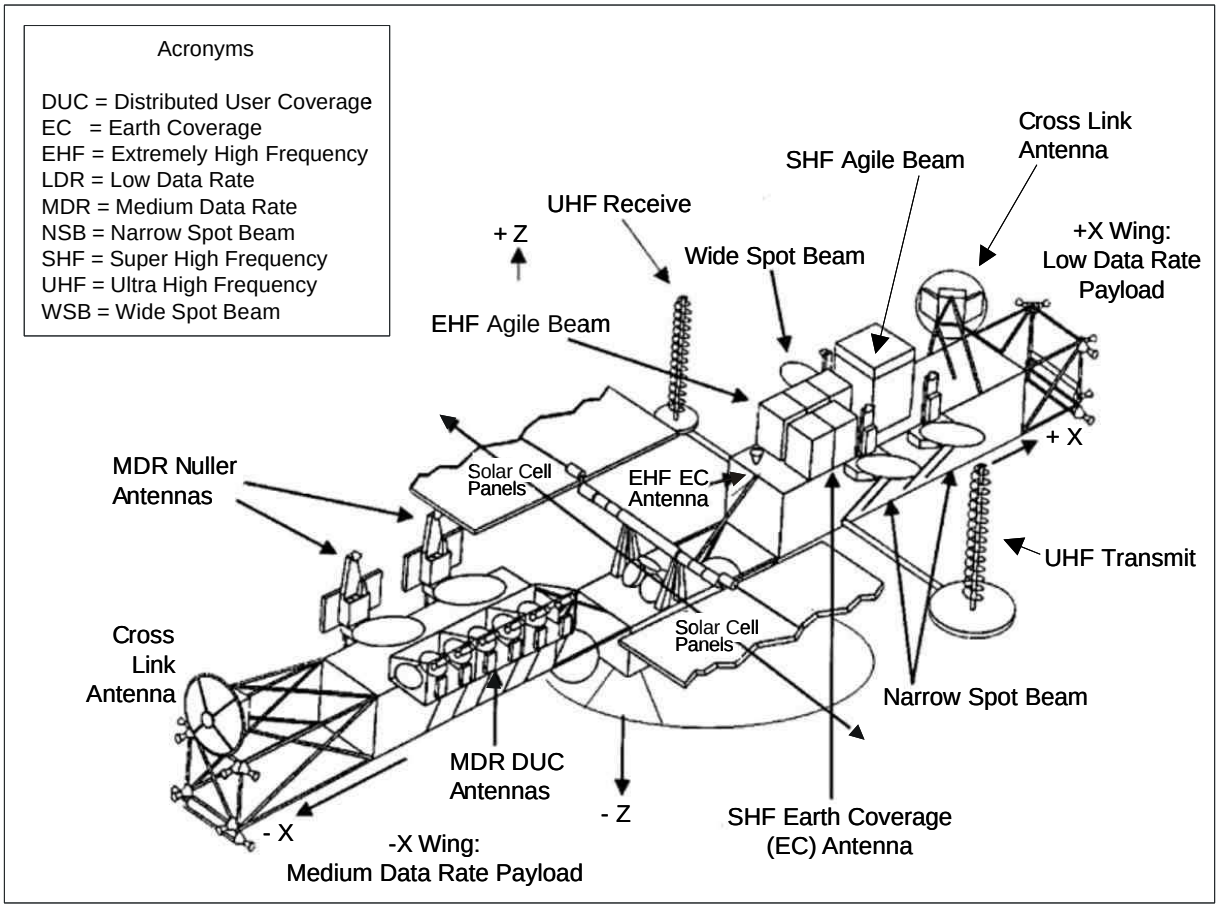


Figure 4-9. Milstar Communications Payload

service data rate is between 75 bps and 300 bps, one to four 75 bps crosslink slots are allocated to the service. If a service data rate is between 600 bps and 2.4 kbps, one to four 600 bps crosslink slots are allocated to the service. Crosslinks for LDR are always configured bi-directional between two or more satellite. LDR services can be allocated flooded crosslinks.

The LDR waveform low frequency hopping and high frequency hopping rates provide true joint interoperability among all service terminals. The high frequency hopping rates provides sufficient processing gain to defeat jammers without a nulling antenna. The downlink agile beam provides increased power over the entire earth coverage field of view. Spot beam coverage can be dynamically controlled by user privileged terminals throughout the earth coverage footprint. Crosslinks join adjacent satellites and provide worldwide connectivity as well as "time" the global constellation to permit instant call set-up, secure connectivity, and secure telemetry, tracking and command signals.

AN/PSC-11, SCAMP

The SCAMP, AN/PSC-11 (figure 4-10) is designed to interface with the Milstar satellite low data rate payload. It can also operate over EHF packages on FLTSAT and UFO. The terminal will operate in point-to-point, network, and broadcast modes providing voice and data services at a maximum data rate of 2.4 kbps. The SCAMP will provide range extension for combat net radio in supporting Army Operations as well as Special Operations. It can provide data-only Mobile Subscriber Equipment range extension. The SCAMP terminal can be paged while in motion and will evolve into a communications on-the-move capability.

The SCAMP is designed to interface with the Milstar satellite low data rate payload.

The SCAMP program is divided into SCAMP, Block I and SCAMP, Block II. The SCAMP, Block I will be used

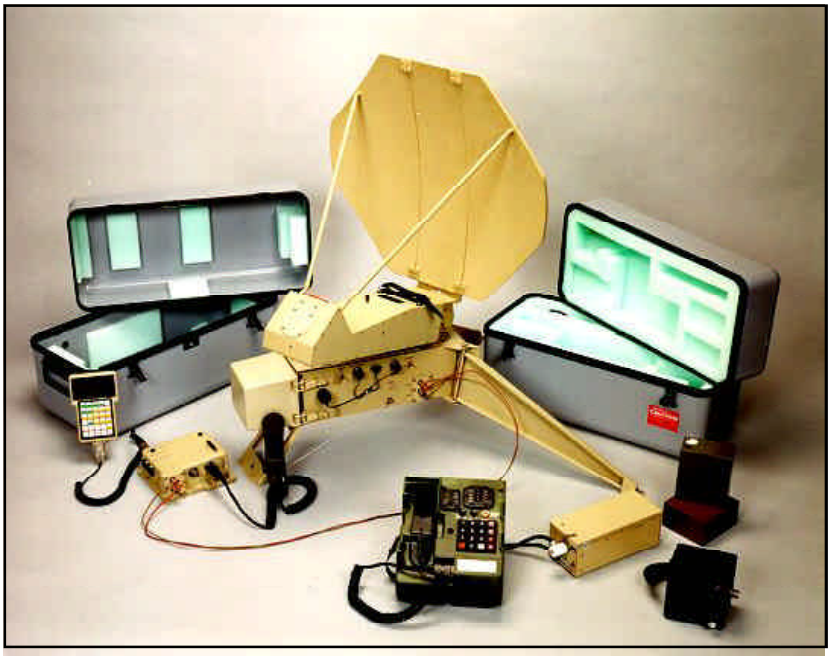


Figure 4-10. AN/PSC-11 Single Channel Anti-jam ManPortable (SCAMP) Terminal

SCAMPs will be user-owned and operated. Users of SCAMP will be located at echelons Corps and below.

for critical command and control communications between headquarters elements and their major subordinate commands. The Block I provides up to four simultaneous point-to-point, network, or broadcast voice and data services. The Block I terminal will weigh approximately 37pounds. The SCAMP Block II will provide point-to-point and combat net radio range extension for conventional and special operations forces. A soldier with full battle load will be able to carry a SCAMP Block II terminal which will evolve from the current 37 pound weight to the desired 12-15 pounds.

SCAMPs will be user-owned and operated. Set-up and tear-down time is within ten minutes. It is interoperable with all Milstar terminals, including those of other Services, and has embedded Transmission Security/COMSEC and Global Positioning System (GPS). The SCAMP has anti-jam and LPI/LPD and exploitation capabilities to reduce the effectiveness of electronic warfare and the possibility of destruction. SCAMP can communicate with Secure, Mobile, Anti-jam, Reliable Tactical Terminal (SMART-T), AN/TSC-154, through the LDR port. Users of SCAMP will be located at echelons Corps and below. Ideally, the SCAMP terminals will be used for critical command and control between headquarters elements and their major subordinate commands.

The primary mission of the Warfighter Net is to provide the Corps and Division commanders with an improved command and control system.

CORPS AND DIVISION SINGLE CHANNEL SATCOM ARCHITECTURES

"The Warfighter Net"

The primary mission of the Warfighter Net is to provide the Corps and Division commanders with an improved command and control system. The concept for the Warfighter Net was an innovation of GEN Frederick Franks, Jr., VII Corps commander during Operations Desert Storm/Shield. He recognized the need to be able to access his subordinate commanders while operating on-the-move, monitor their communications, and synchronize his forces.

Corps and Division Warfighter Networks provide the basic single channel command and operations net. The Warfighter Net passes orders and immediate command and operational information. The commander uses this net for tactical control, combat coordination, and tactical data reporting of combat forces, Long Range Surveillance Unit, and support units such as the Corps/Division support commands, and the engineer units.

Graphical depictions of Corps and Division Warfighter Nets are shown in figures 4-11 and 4-12. TheWarfighter Net comprises Corps and Division UHF SATCOM as well as SINCGARS radios (for retransmissions capability). The Warfighter Net ground terminal is the AN/PSC-7 which is being replaced now by the AN/PSC-5 (Spitfire). The Warfighter Net ground terminal is the AN/PSC-5, Spitfire. Distribution of the terminals is shown below.

- 38 terminals - Each Corps Commander.
- 26 terminals - Each Division (Heavy) Commander.
- 24 terminals - Each Division (Light) Commander.

The commanders distribute terminals based on the mission and their preferences for communications.

The commanders distribute terminals based on the mission and their preferences for communications. Although the intent of the Warfighter Net is that only subordinate commanders/command posts receive a terminal, the Corps/Division com-

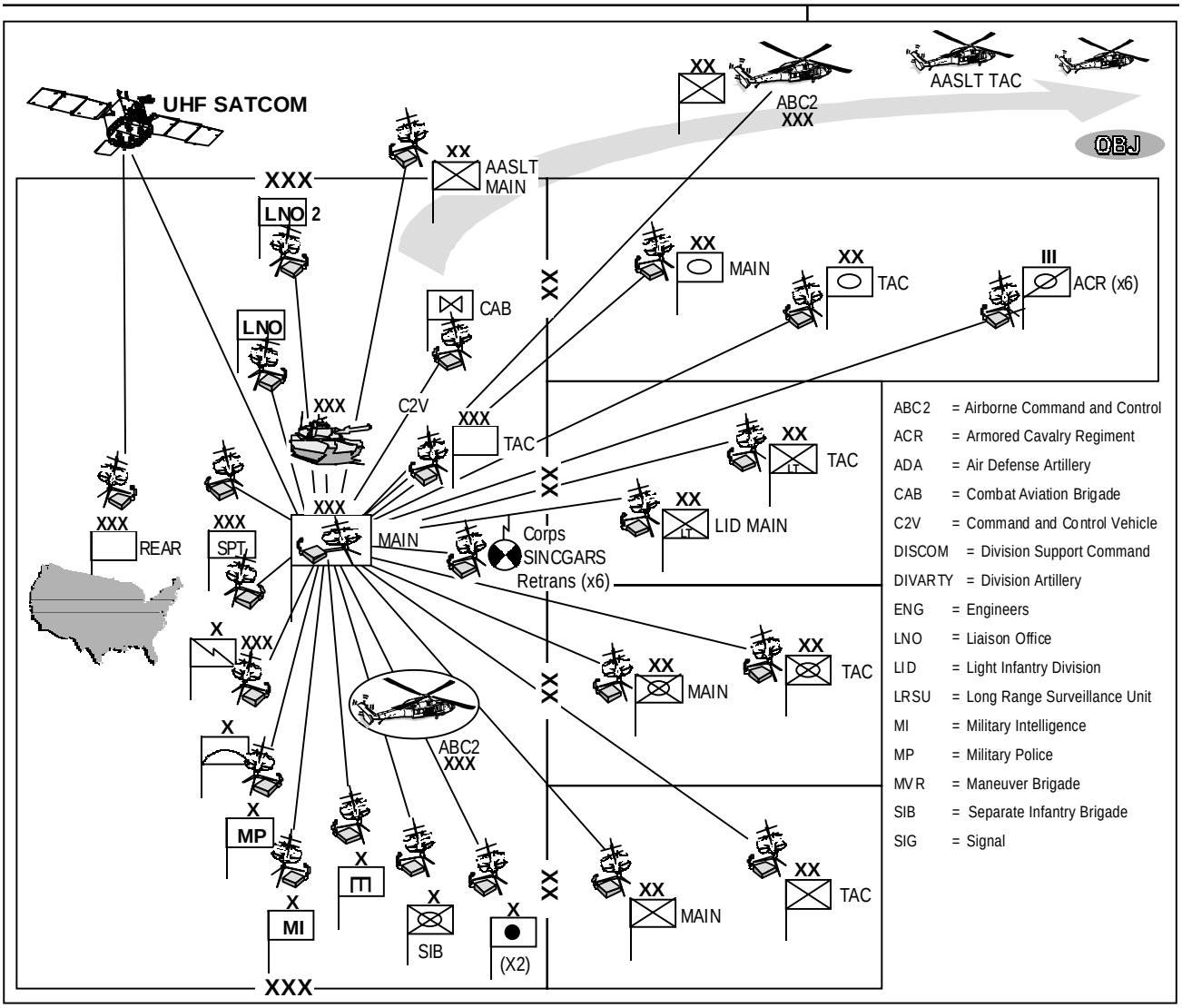


Figure 4-11. The Corps Warfighter Net Provides the Commander with an Improved C2 Net

mander can use the terminals based on his vision of the battle scenario. Flexibility and mobility are an inherent part of this architecture. Members of the Warfighter Net can be located anywhere within the Area of Responsibility (AOR) given the extent of the satellite footprint.

Figure 4-11 shows the Corps layout of a Warfighter Net. The architecture applies to all Corps, not just those assigned with a contingency mission. This figure assumes split-based operations with SATCOM linking the Corps rear and sustaining base with forward deployed units, a scenario which may apply only to contingency corps.

Figure 4-12 depicts a generic division organized for combat. The division commander is always fully in battle. The Warfighter Net parallels the battlefield command structure and permits the division commander to access key subordinate command posts as well as monitor the conduct of operations by all forces under his command.

Participants do not have to have a satellite terminal to be in the Net. Maximum utility of the Warfighter Net is obtained by integrating AN/PSC-5 Spitfire terminals with SINCGARS radios, thereby achieving retransmission capability via satellites. This integration results in adding a single channel SATCOM terminal to one station in the net. SINCGARS retransmission connects those without SATCOM radios. In order to reach forces without direct satellite access, six SINCGARS retransmission systems must be added to the Corps. Corps Warfighter Net radios are provided to divisions, armored cavalry regiments, and separate infantry brigades for maximum flexibility and connectivity in supporting a wide range of battlefield scenarios.

The Warfighter Net requires extensive control and management. The Integrated Systems Control will plan Warfighter Network command and control missions in coordination with the Corps or Division staff. This planning includes the identification of SATCOM terminals and SINCGARS retransmission locations to ensure communications on-the-move between the Corps/Division Commander and subordinate units throughout the AOR.

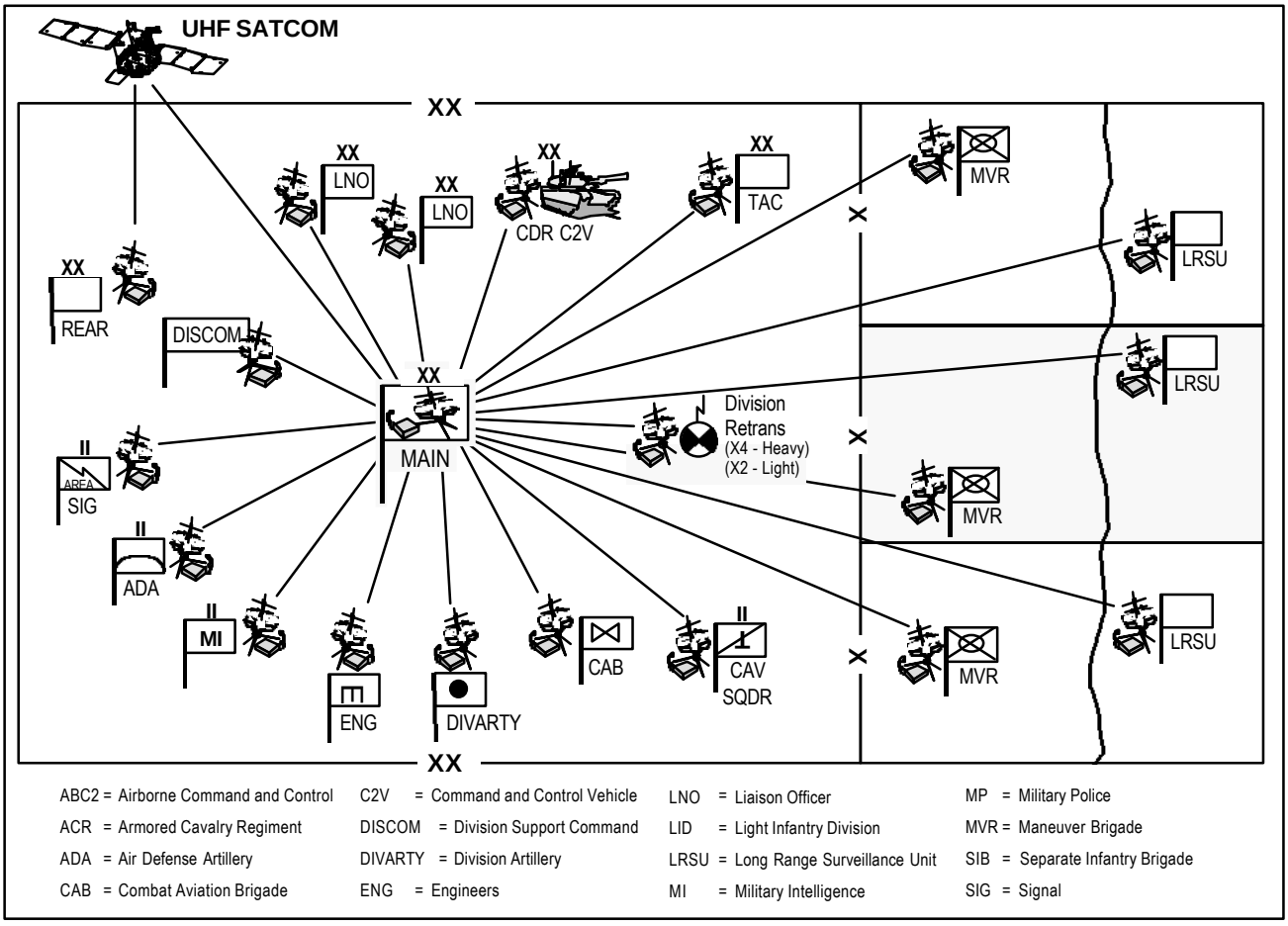


Figure 4-12. The Division Warfighter Net Allows the Commander to Quickly Access Key Subordinate Command Posts

The UHF space segment is fully utilized and channel access is tightly controlled. DAMA should increase the capacity of the UHF band and provide more channels for use by the warfighter.

Communications on the move remains an elusive requirement of the warfighter. He will continue to "outrun" line of sight communications. Commercial SATCOM technology is leading the way in developing small, affordable, secure terminals for the warfighter.

LIMITATIONS TO THE SINGLE CHANNEL SATCOM ARCHITECTURE

Satellite communications have their limitations. Although the Army single channel SATCOM architecture provides a high degree of mobility and capability to tactical operations, Army warfighting requirements cannot be completely satisfied by UHF single channel SATCOM. The limitations are indicated below:

Space Segment Limitations

Limited Capacity

The UHF space segment is fully utilized and channel access is tightly controlled, assigned to high priority users and adjudicated at the Joint Staff level. Although the Army has been provided access during recent conflicts, the principle of assured access cannot be met with the current architecture. DAMA should increase the capacity of the UHF band and provide more channels for use by the warfighter. DAMA is addressed in detail in annex B.

Dedicated Assets

Much of AFSATCOM capacity is dedicated to the emergency action message dissemination mission at 75 bps and requires special terminals. FLTSATCOM is dedicated to Navy command and control. Many other space assets that could provide communications are on classified hosts and are not available to the Army warfighter.

Limited Threat Mitigation

Current technology UHF signals are easily detected, intercepted, and jammed. UHF signals are easily disrupted by natural scintillation.

Satellite Orbits

No single orbit can provide complete worldwide coverage. Geosynchronous orbits do not provide good service to the polar regions. A satellite in a Molniya orbit provides long duration, but not continuous coverage communications . A communications satellite cannot currently be physically repaired while in orbit unless it is in a low earth orbit where it can be retrieved by the Space Shuttle.

Terminal Segment Limitations

Communications On-the-Move

Army mobility considerations necessitate a communications-on-the-move capability. The commander wants to be able to obtain current Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance and Position/ Navigation information while moving on the battlefield. The current terminal architecture can provide only a limited on-the-move capability.

Manpackable Terminals

The Army warfighter requires smaller, lighter terminals than currently available. The AN/PSC-5, being fielded for the Warfighter Net, weighs almost 12 pounds. Although this is lighter than previous militarized versions, it is still not as lightweight as the warfighter desires.

Voice Recognition

Current systems are based on 2.4 kbps voice. Corps and Division commanders have difficulty with voice recognition/vocal stress patterns at this rate. An Operational Requirements Document has been submitted to document the need for this capability.

Situational Awareness

Corps and Division Commanders require a GPS overlay on voice and data circuits to identify "friend or foe" and establish the battlefield parameters. GPS is available today. Lessons learned during Operation Desert Storm proved the value of GPS. Integration of GPS into other pieces of battlefield equipment is under review. A full discussion of GPS is found in chapter 5.

SUMMARY

The Army now uses UHF single channel SATCOM to support tactical battlefield voice and data range extension requirements. With Milstar, the Army has additional capability using the EHF frequency band that is more flexible and secure for the warfighter. The UHF single channel ground terminals are user-owned and operated and can be manportable, manpackable, or vehicular mounted. Single channel SATCOM is used extensively in a variety of missions because of the security and mobility provided. It is also used in deployment operations. The Corps and Division Warfighter Nets use single channel SATCOM exclusively for long-range communications between commanders.

Single channel SATCOM has limitations that include limited capacity. Access to UHF SATCOM channels is tightly controlled and Army users have difficulty obtaining use of these resources. DAMA should increase the capacity of the UHF band and provide more access to UHF SATCOM channels for the warfighter. UHF signals can be easily detected and jammed by enemy forces and they are disrupted by natural scintillation. Current ground terminal limitations include a lack of communications on-the-move capability and difficulty in voice recognition over single channel SATCOM systems.

The Army's single channel SATCOM mission is supported by communications transponders on a variety of space platforms. For the warfighter on the ground who is already burdened with large amounts of life support gear, the use of small, portable, single channel SATCOM terminals is very beneficial. Advancing technology, particularly in the commercial arena, will someday permit even smaller, more secure military SATCOM terminals for the warfighter.

AFSATCOM
Air Force Satellite Communications

AOR
Area of Responsibility

CINC
Commander in Chief

CNR
Combat Net Radio

COMSEC
Communications Security

CONUS
Continental United States

DAMA
Demand Assigned Multiple Access

DSCS
Defense Satellite Communications System

DOD
Department of Defense

EAM
Emergency Action Message

EHF
Extremely High Frequency

FEP
FLTSAT EHF Package

FLTSAT
Fleet Satellite

FLTSATCOM
Fleet Satellite Communications

GBS
Global Broadcast Service

GHz
Gigahertz

GPS
Global Positioning System

KHz
Kilohertz

LDR
Low Data Rate

LES
Lincoln Experimental Satellite

LOS
Line of Sight

MDR
Medium Data Rate

MHz
Megahertz

SATCOM
Satellite Communications

SCAMP
Single Channel Anti-jam ManPortable Terminal

SCT
Single Channel Transponder

SCTS
Single Channel Transponder System

SDS
Satellite Data System

SHF
Super High Frequency

SINCGARS
Single Channel Ground Air Radio System

SMART-T
Secure, Mobile, Anti-jam, Reliable, Tactical Terminal

UFO
UHF Follow On

UFO/E
UFO Follow On/EHF Subsystem

UFO/EE
UFO Follow On/Enhanced Payload

UHF
Ultra High Frequency

USAF
United States Air Force